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NATURAL ANALOGIES.

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In several articles on biological subjects published during the last fifteen years, I have called attention to the importance of analogical reasoning in the consideration of many scientific subjects.

To a limited extent this process of reasoning is carried on by scientific writers generally, but more with reference to its convenience than with a full realization of its great importance; for example, the vibratory theory is made use of by physicists in discussing heat, light, electricity, and sound, and most authors on the correlation of forces, and modern philosophers like Herbert Spencer endeavored to reduce universal phenomena to simple terms such as the convertibility of matter and motion, but from first to last all these thinkers seem to have missed what appears to me to be the most valuable application of analogy to practical sciences.

It does not require much thought to concede that a house built of bricks will possess the properties inherent in individual bricks, such as uninflammability, degrees of porosity, impermeability to moisture and air, and even the colors of the original brick, but it has taken thousands of years to establish the fact that however highly differentiated the animal tissues may be they possess only attributes of the primitive cell, some having one or more abilities highly developed with others in abeyance.

Thus the protozoon eats, grows, reproduces; so does the man, and for the same reasons. Whether we regard the processes as homologous or analogous, these acts performed by every animal have their foundation in the ability of the primitive cell to do the same things. It requires a certain familiarity with zoology and physiology to be capable of appreciating this connection, and it is a hopeless undertaking to try to teach such conceptions to those who are not furnished with the necessary preliminary knowledge. And there are those who are instructed in such matters, who for the want of sufficient deductive ability are unable to see the dependence of the phenomena because to their untrained minds the complicated processes of ingestion, such as deglutition, insalivation, mastication, digestion, etc., apparently differ so radically from the simple assimilative act of the amœba.

The ends attained are identical, though the processes may differ, somewhat as the sun-dial, the hour-glass and the clepsydra differ from the modern watch. No matter how complex the organism, the individual cells that compose it absorb food directly, very much the same as do primitive single-celled animals.

The complicated differentiations, to those unfamiliar with the subject, differ radically from their origin, as Talmage imagines he differs from the ancestral ape.

That analogies have been considered useful in some ways is shown by many attempts to utilize them, as, for example, in the celebrated work of Bishop Butler, whose success in the application Huxley thinks was not very great, for the latter claimed that the story of Jack and the Bean-stalk could be proven by the same method of reasoning. The sloppy manner in which analogies have been selected to illustrate certain points show that while there was acknowledgment of their value there is universal ignorance of their real nature.

I firmly believe that there will eventually be elaborated a science of analogies which will bear a relationship to the imperfect usage of the past in such matters that the old bears to the present zoology and botany.

Spencer makes good use of the method in an essay on "The Social Organism," and pretty generally throughout his works, but I think that neither he nor any other author touches upon the special point which I shall endeavor to make clear in this article.

Superficial resemblances often betray writers into incorrect use of metaphor, figures, or simile, either of which is upon close inspection nothing but a rhetorical admission that analogy has its uses. But its abuses are all too numerous, particularly in attempts at allegory and the puerile fable.

Superstition arises from an imperfect observation of natural phenomena which science dispels by the growth of intelligence with more accuracy of observation; as alchemy and astrology were followed by chemistry and astronomy, so mythology, which is the savage attempt to explain the universe through crude conceptions, is gradually being superceded by philosophic recognition of the unity of the laws governing everything.

One of Lord Bacon's essays is devoted to an ingenious attempt at explaining ancient Greek and Roman mythologies as symbolizing profound wisdom, and no legend among them was too silly not to be reconciled on this basis. The confusingly complex ecclesiastical symbolization is the outgrowth of endeavors to find material equivalents for spiritual things, with such poor success that the Christian can see nothing holy in the crescent and horse-tail of the Mohammedan, while the latter derides the cross as "two sticks," and exclaims "Behold the Christian's God."

And now we come to the main consideration. It is nothing new that there are parallelisms between the acts of men and nations, but these connections were treated of as purely accidental, or at best as if they were caused by some inscrutable law. I am not aware that anyone has preceded me in announcing that so far from there being anything mysterious in such matters the interdependence of phenomena and the possibility of reducing all things, if not to their ultimates, at least to simpler terms, enables many of the operations of the universe to be better understood and simplifies them astonishingly.

But first of all to enable this insight, the scales of ignorance must be scraped from the eyes, for the past system of education that ignored the sciences would create this blindness. Sociological study depends upon a knowledge of biology in its widest sense, comprising such things as anthropology, ethnology, zoology, botany, comparative anatomy and comparative physiology, and the front door to all this knowledge is chemistry and physics.

It may not be possible for any one person to master all these branches in their entirety, and we daily encounter narrow specialists in scientific fields, who, for want of education, cannot see the bearing of all the departments of information upon their particular branch. Such are anatomists who know no botany or chemistry; botanists who know nothing outside of plants; chemists who can see nothing beyond their test tubes and reagents. But, other things being equal, no one is so well equipped to *begin* the study of the universe as is the one with a good training in chemistry.

During the great fire of Chicago it was observed that the marble fronts of the houses seemed to melt in the flames and that the bricks were the really fire-proof material, facts which did not surprise the mineralogist, who, with his chemical knowledge, knows that carbonate of lime readily calcines and that silicates resist heat.

Comparably the philosophical scientist can reason from cause to effect, or backward, intelligently, and see associations that do not exist for the one with purely classical knowledge. A house may be an aggregation of bricks, stone, or wood, and will behave toward fire, water, and air as its component materials enable it, without surprise to anyone, but when communities are made up of human beings the old-time historian never traces relationship in the behavior of one to that of the other. The whole had no relation to its parts.

Even among sociologists who recognize these dependencies, a deeper source of information was seldom sought, such as biology in general, and they might indulge in the general smile of contemptous ignorance if it were hinted that chemistry and physics could aid their research.

To illustrate that analogies have a deeper significance than is usually assigned them, let us take the instance of what has been called a "bread riot." People are starving; they are turbulent, rushing here and there, finally gathering at some warehouse where food is stored, which is soon scramblingly distributed and eaten. This proceeding on the part of the populace is instigated by analogous and in many respects identical conditions existing in each individual of the mob. The collection of cells composing each person are in revolt; they are badly nourished; the intestines, muscles, nerves and their cells are hungry; the blood corpuscles surge through the vessels irregularly and riotously. The white blood corpuscles particularly are more active than usual, exactly as the free amœba moves more rapidly when hungry than when fed. There is starvation excitement throughout the body. The lymph and vascular channels are ransacked for food, and what previously would have been rejected is now assimilated exactly as the starving rabble gather offal from the streets and alleys. The fat repositories are drawn upon with resulting emaciation; the cellular elements are enfeebled, and multitudes of them die, as occurs among the starving populace.

A single cell may become a source of irritation to the colony of cells by provoking action, and individuals seek to impress themselves upon a community by orating, sermonizing, lecturing, quarreling, fighting; all more or less ignorantly are seeking gain.

A modicum of such excitement may result in benefit to the colony of cells, as an individual's action may result in the common good. Great national activity may eventuate in benefit to the world. In all these cases the good done may be accidentally accomplished. An epidemic of insanity may become as wide-spread as during the crusades, as crazy physiological processes may be induced by a fever.

Metzchnikoff's description of phagocytosis, interestingly reviewed by J. L. Kellogg in THE AMERICAN NATURALIST, June, 1891, quotes Osler's summation as follows: "He says that Metzchnikoff has likened specific inflammation to a warfare in which the invading forces are represented by micro-organisms, and those who offer resistance by leucocytes. The news of the arrival of the enemy is telegraphed to headquarters by the vaso-motor nerves, and the blood-vessels are used as an avenue of communication with the threatened region. When the invaders are established they live on the host and scatter injurious substances which they have formed. The active leucocytes make an attack and try to eat the micro-organisms, and some die in the fight. Their dead bodies form an accumulation of pus, and when many are slain the battle-ground is known as an abscess. The hostile force may be overcome resulting in the recovery of an animal, and if not, in its sickness or death. In our bodies, then, there is a standing army of moveable cells, which may be equally concentrated and attack any force which may appear."

Now let us see what chemistry will afford in further explanation. In plethora the cell is quiet. When sufficiently nourished it performs its functions calmly and deliberately; its basic substance, the living protoplasm, was defined by Hoppe-Seyler as consisting of anhydrous nitrogenous hydrocarbon molecules capable of motion in a hydrated medium; the dead protoplasm resulted from the hydration of these molecules; the assimilative, reproductive abilities of the cell depended upon this molecular life, while this compound molecule existed intact and was able to construct, develop and differentiate similar molecules out of the less complex by chemical affinity. The molecule lived and was part of the cell, which was part of the man, which was part of the mob.

In a condition of surfeit no one would deny that a molecule was comparatively idle, but during privation its tension is necessarily increased, and there is danger of its breaking down into its component elements or forming lower compounds.

Other sociological relationships may be traced, and in a loose way the human organism has been likened to a monarchy. In a series of articles entitled "Monistic Mental Science," published in the "Open Court," 1887, I took the ground that the ideal, highest man was a republic; that the association of cells throughout his body cohered and worked, or should do so, in health, for the common good of the organism; that the nervous system, including the brain, related the parts intelligently to conserve life purposes. The nervous system governs the body, but it receives its power to do so from the aggregated cells, and in this sense is a republic, and proper consideration of analogies will eventually work out clear conceptions of the social organism. It is the common idea that kings, parliaments, presidents, legislatures, congress, constitute the brains of society, when in reality they are one and all intestinal ganglia.

The Chinese locate intelligence in the abdomen, and the European, without being aware of it, mistakes abdominal for intellectual processes, and here is an instance where a better appreciation of things in general can be arrived at analogically. The real brains of a community consist of (it would seem trite to say) those who think, particularly those who think for the common weal; the philosopher, the scientist, the investigator stand in the front rank as brains; even the inventing mechanic should have high rank, and all such thinkers, in spite of the fact that they are not so recognized popularly. Heretofore, and to a great extent to-day, the real brains of a community are neglected, starved. In times of dearth they are the first to suffer, just as the reasoning power abates in sickness, and emotionalism develops.

In this and other respects a clarifying of our conceptions must occur before natural analogies shall be recognized as capable of being erected into a science. At present in this respect we are in a blundering, forming stage. Superficial resemblances for the most part have been used in analogy, and its profundity and capacity for exactitude have not been seen. One consideration alone baffled the carrying out of analogies, and that is, that in comparing an organism to a nation, it was considered necessary to make use only of living material, when in reality living material coheres with the inorganic, or what is called the "formed or dead material" of Beale. In the functions of the body there is use for such parts as the bones, just as machinery of all kinds, the telegraph, etc., are essential parts of a social organism.

The cells of the body are used up, die, or are cast off, but the man lives on. The individuals of a city perish here and there and are buried, until in a few generations there is an entirely new population, but the city, more or less changed, still exists. The molecular interchange of the cells is identical with this, and while so far as time and general processes are concerned there are differences, the operations of the nation depend upon the organism function, this upon the cellular, and the cellular upon the molecular. Nor are the activities so radically changed as we might imagine. The whole end and aim, physically speaking, is the conversion of molecular into mass motion, death reversing the process. The molecular life may be less than a minute; the cell life duration cover a few days or longer time; man may live nearly a century; the nation ten times as long or longer, but disintegration in some form or other overtakes them all, and history has to be studied in a new light to determine when the death took place.

The hermit crab is not the builder of the shell he lives in. Egypt will some day be wholly occupied by Europeans, and so in regarding the life of a city we may mistake the persistence of a shell and overlook the fact that the social organism which constituted the real city may have long since passed away.

Sociologically, merchants, bankers, etc., are the nation's intestinal or other visceral cells, and that they do not eat up everything that passes into their custody is solely due to their not being able to do so.

Common carriers may be the blood-vessels.

Telegraphs and other such means of communication constitute the nervous system.

Laborers, soldiers, are the muscle cells.

So-called rulers and law-makers (whether in republic or monarchy), merely obtain their power from the general units, and serve to correlate the intestinal and vascular operations as the sympathetic system does.

The professors, authors, and other real thinkers generally afford the unrecognized brains of communities, however starved and neglected; and, as individuals are usually guided emotionally and think afterward, so the real brains of a community are disregarded in the main.

Pathological conditions infest communities as well as individuals, from want of harmonious working of parts. When the elaborating, transferring apparatus of a person or nation, as the intestines and blood vessels, or merchants and railways, either separately or together, become too selfish, and want to absorb everything, it is an easy matter to induce the intestinal ganglia legislature to adjust means for so doing; but, as this means death to the organism in general, a feverish condition may follow that threatens the national life until an equilibrium is restored. The intestines are often traitors to the commonwealth, but so may be other associated parts.

The workings of the nervous system, especially that of the spinal cord with its gray centre and white columns, may be explained some day by an application of electrical laws, particularly when the latter shall be better understood. New principles are yearly being worked out in this realm. Carefully applied reasoning may enable *an explanation of physiological mysteries* that cannot be possibly arrived at any other way. Many of the viscera are not so well understood as they should be. The functions of the spleen, liver, and pancreas, while much better known than formerly, are still to a large extent "sub judice." Analogies may enable us to better understand these parts, and in turn a better understanding may be reflected upon sociological and other matters.

In the American Journal of Psychology, Jan. 1890, the following comment occurs on the discussion between Weismann and Gotte (*über die Dauer des Lebens, und der Ursprung des Todes.*) "We may illustrate Gotte's idea by an analogy. Essentially there is no difference in the idea of death as applied to biology and as applied to the death of a literary society when the members agree to disband, possibly to found new societies. If we could feel sure that the analogy is sometimes more than a mere analogy, but at bottom is a universal principle of life, we could gain immensely by the mutual comparison between sociology and biology. There are many terms and ideas common to the two sciences, such as division of labor, development, atavism, colony, etc. Reproduction by self-division might be illustrated by a splitting of the tribe into two. Budding, by the founding of a colony by emigration of individuals representing different trades needed in the new colony. Sexual reproduction, by emigration of a single couple, and the gradual development (embryology) of the colony with differentiation of labor as the individuals increase in number. The individual in this illustration represents the gemmule. The integrity of a state does not depend upon the number of persons, though the amount of its activity and wealth does. Similarly in the cell, the gemmules may be of like nature, and vary much in number. Here the illustration favors the view of Kolliker rather than Weismann.

"Although the work of two persons may be different, they are essentially alike in characteristics, and the descendants of any person in a state could found a similar state if forced to do so by emigration."

The same journal in the connection of criminology, suggests that "the whole study of pathological humanity may do for humanity what pathology has done for medicine."

Analogy (which is often identity) may be used to illustrate psychological processes. For example, the individual thinks pretty much as the social organism does. Seldom is a community wholly guided by superior thought. Its mercantile, transportation, and intercommunicating machinery is hard at work on the victual and clothes question. Amusement comes next. If a subject such as popular reform, inebriety, education, comes up, any person with advanced views will be talked at and about, by silly vaporers, and his ideas will be contested; this or apathy may smother the measure, the organism goes blundering on, guided by average expediency.

Methods of rural village, town, and city workings are comparable to those of individuals with different degrees of wealth and intelligence. As in higher animal life there is better co-ordination and correlation of parts, so in the growth of a community there is a tendency to increased subordination to intelligence, for the higher grade intellects may eventually impress their ideas upon the commonwealth.

Sulphur, carbonate of lime, silicates, chloride of sodium, and other inorganic substances enter combined or uncombined into the composition of carapaces, shells, bones, serum of living animals, pretty much as telegraphs are integral parts of the social organism. Several years ago in a work entitled "Comparative Physiology and Psychology," I argued that primarily, some of our ancestral animals accidently picked up a nervous system, consisting of phosphatic granules, which became linearly arranged by action in the line of least resistance, forming axis cylinders which became encapsulated, precisely as do many foreign substances in the body.

Professor Cope advanced the doctrine of "Acceleration," by which is meant that every time an ontogenesis is reviewed, the characters appear at earlier and earlier periods, or in other words, the developmental history is compressed to give room for the later added requirements. Adapting this to national matters, the United States seems to be rapidly passing through stages which required ages, comparatively, in older nations.

Written languages tend to become phonetic in spelling; more rapidly in America where conservatism is not so strong as in England, less rapidly in France owing to euphony being paramount; in Spain, Portugal, and Italy, it has been accomplished for many decades, radically in the last named country; in Germany there would seem to be little to be accomplished in this direction, but in the last twenty years the silent letter "h" may be omitted. Conservatism holds on to unpronounced, absolutely useless letters under various pleas and biases. How very like this is to the unfaithful copying of ontogenesis by phylogenesis. The abridgment occurs in the interest of the individual and the race, with here and there fossilizing tendencies against alteration.

The rapidity with which phonetic spelling advances in America indicates that Cope's law of acceleration is at work to develop the United States in this as in other regards beyond the capabilities of its senile parentage. Many other useful innovations are similarly made and meet with resistance. And yet without conservatism there would be no advance, for, in general, resistance to the new until its utility is demonstrated, prevents the adoption of many vagaries.

In past generations, boys up to fourteen and sixteen years of age were greatly influenced by dime novel, Indian and pirate tales. No matter what the cause may be (probably the dissemination of better reading matter), it is the boy of ten years, or younger, nowadays, who affects such reading, and this may be likened to a condition existing in the days of knight errantry, when cock and bull stories of fights with dragons and giants were rife among every class of adults. Bombastic and emotional influences for centuries back existed generally among all, and more recently the Capt. Marryat style of novel lured young men to become sailors, and in some instances, pirates.

As the individual repeats in his life-time the history of the world, so to speak, he must pass through the stages of puerile belligerency, until he profits by his own experience, or that of others, and a boy of to-day, by the law of acceleration, passes more rapidly through these periods than did the one of a generation ago; and going back we find a period when a lifetime was required to outgrow this disposition.

Friends fall away during misfortune and are attracted to wealth and power, in obedience to laws which are identical with those that create parasites among plants and animals and the so-called messmates of the latter: the attraction of single and multiple celled organisms to food; and all these find their fundamental causes in laws of chemical attraction and repulsion of atoms.

Increase in chemical and mechanical motions often induce atomic interchange and molecular motion and recombination; as for instance, stirring a compound to produce precipitation or crystallization, changing the temperature of re-agents to produce a reaction, heating a battery to increase electrical generation, and so massage or bodily irritation draws blood to a part and stimulates physiological processes.

The stirring up of individuals by excitement increases the working capacity, and communities are similarly affected by causal relationship in these matters. If a nation is impelled to greater activity through mental influences, it is because the molecular makeup of many of the individuals composing the nation is in a state of changed activity.

Without the atoms there would be no cells; without the cells no man; without the man, no nation; and activities among either affect all of them. For many years as a student of diseased mental processes, I have often satisfactorily combated such things as delusions of persecution, morbid fears, apprehensions, and fright, particularly in incipient insanity, by an application of the following reasoning:

In a healthy state, a fright produces certain sensory and motor phenomena in the body, such as rapidity of heart action, capillary dilatation and contraction, temporary muscular paralysis, and in extreme cases, perspiration and loss of sphincter control. Now as these are the usual expressions of fright, it is plain as anything can be that if disease may so interfere with the nerve mechanism as to produce any or all of these associated effects, it would be natural for the mind to interpret them as being due to the usual cause. For example, fear may make the heart beat fast. I have known an organic disease that interfered with the pneumogastric branches at the base of the brain, or with the cardiac sympathetic nerves running from in front of the spinal column to set up irregular heart action, and a feeling of dread or apprehension, or even terror will be thus caused by association, unless some compensating influence, which is not usual, interferes.

By artificial regulation of the heart's action, both the physical and mental disturbances may be caused to cease. Evidently a fright stimulates the heart muscle to greater activity, necessarily causing greater commotion among its cellular molecules, and the reverse condition is also true. The molecular action of the heart muscle may produce fright.

I would divide analogies into two particular classes, the apparent, and the real. The fact that as we advance in knowledge, resemblances in the mode of operation of widely unlike phenomena are being more clearly seen, and that even by the lowest races, resemblances are more or less accurately traced, justify the prediction that some of our greatest revelations of the universal workings will be obtained through a scientific study of analogies.

The apparent analogy may be taken as tentative, or it may be wholly false, or merely poetical, such as is afforded us by the allegories and mythologies, and even scientific writers may find a use for an apparent analogy in illustrating certain matters.

The real analogy is such by direct interdependence and relationship, and the great difficulty in determining its reality lies in the necessity for the accurate understanding of these relationships.

It is not possible for any one human mind to be thoroughly versed in chemistry, physics, biology, psychology, geology, and astronomy, and for this reason the one who may be familiar with one or two branches and have a fair knowledge of the rest, will be able only to generalize, but his suggestions could be heard and amended by a worker in complementary fields, and eventually a synthetic study can be erected, unifying what is known in these various departments, and thus astronomy may come to explain a problem in microscopy; biology may clear up a chemical point; and sociology, in the light of the other sciences, may explain an otherwise inscrutable physological matter.

Necessarily the history of the past may thus be laid bare, and ethology may become a science such as David Hume little dreamed of. The reasons for behavior, the feelings, passions, vices, and virtues, may thus be seen. It will be found that we are truly creatures of circumstance.

The significance of institutions may be more easily understood in their relation to the commonwealth. We may be better able to determine whether a measure will be useful or harmful, for example, when we make comparisons of certain physiological processes with sociological ones, there may arise a necessity for assigning a certain contemplated national movement to its proper place in the general economy. These comparisons may enable us to prove that instead of being a newly evolved useful structure, it may be in the nature of a cancer or an ulcer hostile to the national life.

Plato's model republic was founded upon vague correspondences between mental and social divisions. Under Reason, Will, and Passion, he placed counsellors, the military and the people, and Hobbes pictured the State as a monster "Leviathan." Herbert Spencer deserves full credit for formulating many analogies in the light of biology, and in the essay on "Social Organism" lays down parallelisms and leading differences well worth studying. Some of which are as follows:

The differentiation of labor is universal in all kinds of development.

Among primitive people the ruling class is comparable to the ectoderm, the governed to the entoderm, and when with later evolution the trading class was created, then the mesoderm arose, which furnished the distributing avenues. This may be taken to represent Europe in the feudal period.

Great activities in society may abstract capital in one direction at the expense of another, just as over cerebral excitememt may draw blood from the abdomen and cause indigestion. In the lowest animals there exists no blood. Among aborigines there is no circulating medium.

Circulating methods and channels increase in complexity in the ascending scales of animal and national evolution.

The growth of a consolidated kingdom out of petty baronies is like an advance among the species of Articulata. Closer commercial and governmental unions between the several segments subordinated to a cephalic ganglion.

England of to-day, Spencer would compare to some much lower vertebrate form than the human.

Parliaments discharge functions that are comparable to those discharged by the cerebral masses in a vertebrate, he says in the essay, but he refused a seat in parliament, as he denied that it was any place for a high order of thought, stating that that body did not govern or make laws, but merely promulgated what was indicated to it by extrinsic (mainly popular) influences. And in this idea of the legislative and executive being the cerebral and cerebellar parts lies a great field for discussion.

My view is that scarcely any nation has much more than passed the invertebrate stage. At least all are pretty low in the Simian scale, if as far advanced as that. Some may be likened to ferocious gorillas, brutal baboons, capering lemurs. The highest are scarcely as thoughtful as the chimpanzee.

But seriously, the Science of Analogies, merits very deep consideration as promising revelations obtainable in no other way in chemistry, physiology, biology, sociology, in all their ramifications. The orbits of the planets have been with reason found analogous to molecular rotations and between the atom and the star lie universal principles applicable to a better understanding of mental and physical laws of animals and society. History will by its means be read in a new and brilliant light, and the ideal nation may possibly be evolved from the better understanding of what would constitute one.